A 'SMART' CAPABILITY FOR ACQUIRING ARMY WEAPON SYSTEMS AND PLATFORMS

Dr. Myron Holinko, Richard Pei, James Wagner,
Dr. Nancy Bucher, Gregory Tackett, Arthur Adlam, and John Brabbs

Introduction

The U.S. Army continues to face a wide array of challenges as it prepares to win future conflicts and contribute to peace in this century. However, the face of the battlefield has changed significantly because of the increased range, precision, and lethality of weapon systems. Warfare has transitioned from a "platform-centric" battlespace to an "information-centric" battlespace. This change mandates new capabilities in the acquisition community to establish a robust, diversified, and agile capability or process for effective collaborative research, development, and engineering for these "system-of-systems."

Fortunately, the evolution of simulation capabilities and technologies now enables the interactive use of disparate simulations. This development, coupled with powerful desktop computers and workstations that are networked together, provides a mechanism to address system-of-systems challenges. Simulation is no longer a method of "last resort" but an integral part of the materiel development process.

The Army Materiel Command (AMC) is meeting this challenge by developing the AMC Research, Development and Engineering Center (RDEC) Federation. This modeling and simulation (M&S) federation capitalizes on previous AMC RDEC work on separate but related programs. These programs vertically integrated M&S capabilities in the AMC RDECs for their respective functionally related mission areas such as command and control (C2). However, the critical need to transform these individual programs into one synergistic entity that is both vertically and horizontally integrated across functional domains has served as the impetus behind the AMC RDEC Federation.

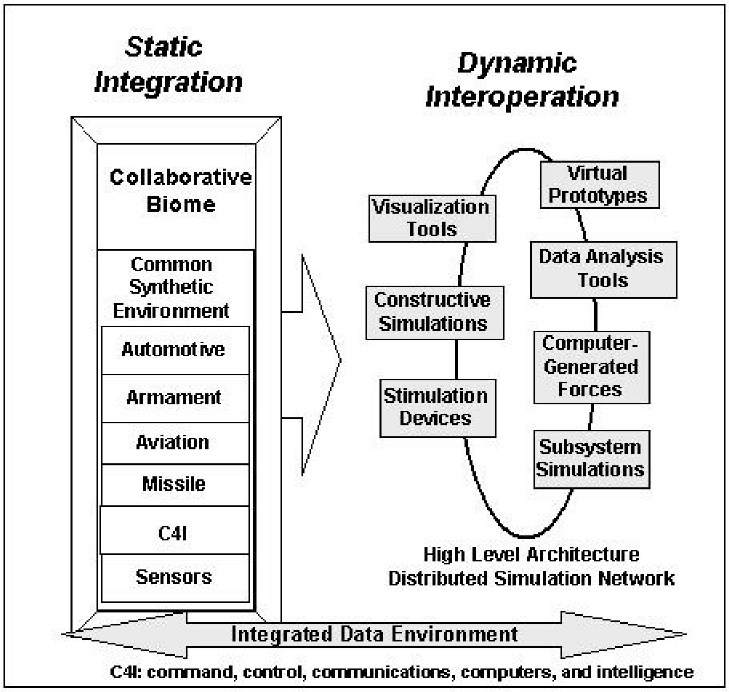
As used in the article title, the word "SMART" has two definitions. It's prudent to develop a *smart* (intelligent) approach to acquire weapon systems and platforms, but most important, SMART represents the realization that this federation directly supports the Army's Simulation and Modeling for Acquisition, Requirements and Training (SMART) initiative.

SMART is the Army's implementation of DOD's Simulation Based Acquisition (SBA) initiative, which is aimed at reinventing the systems acquisition process through collaborative use of information and simulation technologies. Army leadership believes that the acquisition process is continuous—from the warfighter identifying a material deficiency through system disposal. Thus, M&S should be applied throughout the Army's acquisition, requirements, and training communities—a systems approach.

Vision

The vision for the AMC RDEC Federation is to develop an AMC-wide distributed M&S environment. This environment will allow the research, development, and acquisition community to have wide access and linkages for the integrated use of diverse models and simulators at each of the federation partner's facilities.

Federation partners include the Army Communications-Electronics Command (CECOM), Fort Monmouth, NJ; the Army Aviation and Missile Command (AMCOM), Redstone Arsenal, AL; the Army Tank-automotive and Armaments Command (TACOM), Warren, MI; the Army Simulation, Training, and Instrumentation Command; the Army Research Laboratory; the Army Soldier and Biological Chemical Command; and the Army Corps of Engineers' Engineer Research



RDEC Federation Functional Components

and Development Center. The federation will provide the capability to address design issues from both the individual system and the system-of-systems perspectives for the optimal development, integration, and evolution of information, communications, mission equipment, and platform technologies.

To provide a structure to oversee this development, an integrated process team (IPT) is being chartered by AMC Headquarters. An IPT charter, currently under development, will give this IPT the authority and resources to plan, conduct, coordinate, integrate, and execute all actions necessary for the establishment of the federation. Of the many critical tasks this IPT will conduct, a most critical task is to identify and develop the required architecture, infrastructure, and concepts of operations to enable the federation to support the SMART/SBA process.

The M&S tools and techniques used within the federation will depend on the technical requirements of a given experiment and the required product. In some instances, work can be conducted locally within one simulation complex. However, when high-fidelity engineering models or hot benches comprising multiple systems and subsystems are required to represent the mission battlespace and test environment, they will be provided by the appropriate federation facilities via networked simulations using high level architecture (HLA).

HLA defines major functional elements, interfaces, and design rules pertaining to DOD simulation applications and provides a common framework in which specific system architectures can be defined. The RDEC federation will be HLA-compliant and will allow all stakeholders to collaborate virtually during the systems acquisition process and share information and data developed during this process.

Development

The implementation of the AMC RDEC Federation focuses on development of two complementary functional components (see figure). The collaborative biome (CB) component provides for the static integration of virtual models while the HLA Distributed Simulation Network component provides for the dynamic interoperation of simulations incorporating the models developed in the CB. When used together, these two components facilitate implementation of the design-collaborate-evaluate (D-C-E) materiel systems development construct.

The CB component will be the virtual community where a multitude of models and collaborative environments can interact to perform SMART activities. There is currently a high degree of internal integration (vertical integration) of model suites within each AMC RDEC (e.g., Communications and Electronics RDEC). The thrust of the CB component is to horizontally integrate these model suites and collaborative environments across the RDECs, thus facilitating interactive collaborative materiel development. This capability is currently lacking at AMC. Implementing the CB will allow the simultaneous interactive design of platforms, associated sensor suites, platform armament systems (missiles), and other necessary components at the RDECs.

This CB component is being developed by Illgen Simulation Technologies Inc., Santa Barbara, CA. This ongoing effort will provide an initial capability for three to five models to be horizontally integrated across several RDECs and is expected to be completed by the time this article is published. Future efforts will result in additional models being integrated horizontally and vertically within several RDECs. Leading-edge technologies such as Jini, Java, Common Object Resource Broker Architecture, and eXtended Markup Language will provide for integration and interoperation of virtual prototyping tools. They will also allow access to data such as resource repositories among the various collaborative environments already implemented by the AMC RDECs.

The results of the virtual prototypes produced in the CB carry over to the dynamic component of the AMC RDEC Federation—the HLA Distributed Simulation Network. This dynamic component, using performance and other operational and environmental simulations, will perform mission-effectiveness evaluations for the system designed in the CB.

A critical component for developing the HLA Distributed Simulation Network focuses on formulating and implementing the AMC RDEC Federation Object Model (FOM) to enable seamless interoperation of HLA-compliant models and virtual prototypes in simulation experiments and exercises. An FOM defines the essential classes of objects, object attributes, and object interactions to enable implementation of HLA. By iterating between the CB and the HLA network, a D-C-E construct can be implemented.

D-C-E

D-C-E methodology provides the bridge between the CB and HLA Distributed Simulation Network. The CB will allow multiple, interactive iterations where an engineering team optimizes the design and function of a system. This engineering team can be dispersed throughout the country at different RDEC locations (e.g., Redstone Arsenal, Fort Monmouth, and Warren), but by using networked collaborative environments made interoperable through the CB, they can interactively design a combat platform. However, to evaluate the mission effectiveness and contribution of this system in a system-of-systems environment, this virtual simulation developed in the CB must be inserted into an appropriate dynamic environment.

This dynamic environment, the HLA Distributed Simulation Network, is composed of appropriate simulations (modular semi-automated forces, Tactical Internet Model Suite, etc.) that add the functionality required for this virtual prototype to operate and be evaluated in a system-of-systems environment and interact with the myriad of other systems and sensors in its battlespace. The HLA Distributed Simulation Network allows these simulations to interoperate during runtime at or near real time. For example, a combat platform must interact with other combat systems in its parent combat formation (platoon) as well as sensors, artillery, aviation, C2 systems, and communications networks, to determine that system's contribution to overall mission effectiveness.

By operating under a D-C-E construct, a system—and a system-of-systems—can be iteratively optimized while taking into account all components that affect the functionality and effectiveness of the system under test in the HLA Distributed Simulation Network.

Once a system has been evaluated in the dynamic interoperation component, an assessment can be made of platform effectiveness and contribution, and insights can be made about how to improve system effectiveness. These changes can then be made in the CB component, and the cycle begins again and is repeated until the system is optimized for its intended mission and expected mission outcome.

Conclusion

The AMC RDEC Federation development effort addresses and corrects a twofold shortcoming in current engineering-level M&S capability. This federation, through its CB component, allows RDEC static engineering design tools to interoperate between RDECs during the design and development process. Additionally, the use of an HLA-compliant federation to perform dynamic evaluation of systems developed in the CB allows implementation of the D-C-E concept.

As the Army develops more complex systems operating in a system-of-systems environment, it's imperative that the capability represented by the AMC RDEC Federation be quickly developed and used. The Future Combat Systems Program is the centerpiece for Army acquisition as the Army develops an objective-force capability. Without initiatives such as the AMC RDEC Federation, it will be difficult, if not impossible, to design and evaluate systems in a system-of-systems context for the future force.

DR. MYRON HOLINKO is the Associate Director for Integration at CECOM RDEC. He has a Ph.D. from Temple University and is a member of the Army Acquisition Corps.

RICHARD PEI is the System-of-Systems Integration Project Officer at CECOM RDEC. He has an M.S. degree in industrial engineering from Texas A&M University and is a member of the Army Acquisition Corps.

JAMES WAGNER is the Director of the Digital Integration Laboratory at CECOM RDEC. He has an M.S. degree in computer science from the Stevens Institute of Technology and is a member of the Army Acquisition Corps.

DR. NANCY BUCHER is the Manager of the Advanced Modeling and Simulation Complex at AMCOM. She has a Ph.D. from the University of California, Berkley, and is a member of the Army Acquisition Corps.

GREGORY TACKETT is the Distributed Simulation Manager for AMCOM RDEC. He has a B.S. degree in physics from Mississippi College and is a member of the Army Acquisition Corps.

ARTHUR ADLAM is the Executive Director for the Virtual Prototyping Group at TACOM. He has an M.S. degree in mechanical engineering from Wayne State University and is a member of the Army Acquisition Corps.

JOHN BRABBS was formerly the Team Leader of the VETRONICS Simulation Facility at TACOM. He has an M.S. degree in computer science from Oakland University and is a member of the Army Acquisition Corps. Brabbs left government service in January 2000.